Open Science: Why (Not) Use It?

Sânziana M. Bompa

S3650219

Department of Psychology, University of Groningen

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Supervisor: MSc Joyce M. Hoek

Second evaluator: dr. J.P. Ineke Wessel

In collaboration with: Robert van Ark, Kaiti Evgeniou, Colm Ó Fuartháin, Rafael Funke and Larissa Hoß

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Abstract

The current pilot study aimed to investigate three aspects of status quo open science (OS) practice: a) how familiar are social psychologists with OS (practices), b) to what extent do they practice OS and c) how to facilitate OS practices in the future. Social psychologists (n = 246) from five Dutch universities were contacted by email and were invited to participate in our survey. Using a mixed methods design, descriptive statistics (n = 70), as well as three exploratory correlational analyses (n = 59) were computed. Results show that participants who reported participating in the reform movement showed higher degrees of identification with the movement. Interestingly, the OS practices that were currently practiced least (e.g., registered reports) were most desired in future work. Training, perceived confidence in training and environmental support to practice OS were inconsistently and weakly related to some OS practices (preregistration, open data, open materials). Finally, a thematic analysis revealed that participants distinguished between the community surrounding the OS movement and its practices, often having negative associations with the former. This negatively affects a participant's relationship with practicing OS. Additionally, time, funding and education were essential resources to facilitate practicing OS. Particularly, OS-centered education for early-career researchers and students was coveted. Directions for future research encourage a larger and more diverse sample, as well as clearer distinction between the reform movement and specific movements related. Importantly, further research is needed on factors that motivate researchers to employ specific OS practices, and under which conditions they employ them.

Keywords: open science, social psychology

Open Science: Why (Not) Use It?

Replication and the degree of reproducibility of scientific work are quintessential pillars of assessing the reliability and validity of the phenomenon studied (Francis, 2013). Subsequently, replicability is recognised as a fundamental component of scientific research by the majority of the scientific community (e.g., Galak et al., 2012; Maxwell et al., 2015; Miller, 2009; Plesser, 2018; Roedeiger, 2012; Simmons et al., 2011). However, several recent systematic reviews and studies (e.g., Ioannidis, 2005; Nosek et al., 2012; Open Science Collaboration, 2015; Simmons, 2011) reported concerningly low rates of replicability of previous studies, resulting in a loss of confidence in modern scientific findings. This phenomenon, now known as the replication crisis, emerged in the early 2010s (Wentzel, 2021). It is currently widely accepted as an urgent issue that compromises the quality and credibility of scientific research (Baker, 2016).

In response to the crisis, a reform movement emerged, consisting of individuals concerned with seeking efficient systemic changes to restore scientific integrity (Houtkoop et al., 2018; Plesser, 2018). Though a wide range of solutions have been proposed, of particular interest to this thesis is open science (OS) - an approach to conducting research prioritizing transparency and open communication about methods, materials and research outcomes (Kathawalla, Silverstein & Syed, 2021). Such practices include preregistration, open access (OA), open materials and code and open peer review (OPR). Recent reviews suggest increasing OS implementation, though at slow rates (Schwartzbach, 2021). Issues such as lacking resources (funding, time, education) and systemic imbalances inhibit efforts to facilitate OS (Gownaris et al., 2022). Therefore, this thesis aims to investigate how acquainted social psychologists (SPs) are with OS, how much OS they implement in their work and what factors influence using OS.

Why OS?

The OS movement endorses a transition from rewarding research outcomes to rewarding the quality of one's theoretical framework and rigorous methodology instead (Stürmer et al., 2017). Although OS practices are not novel concepts, modern technology (e.g., the Internet) allows these practices to be applied differently and increase transparency and diversity in an unprecedented manner (Spellman, Gilbert & Corker, 2017). For example, granting OA to research can increase science literacy and empower laypeople by helping them make more informed decisions (Field et al., 2021, preprint).

Spellman, Gilbert & Corker (2017) praised OS as a modern return to core scientific ideals of research conduct (e.g., Cronbach & Meehl, 1955; Merton, 1942/1973). However, establishing OS as a legitimate scientific paradigm is hampered by a lack of OS-centered education, as well as deep-rooted misguided academic incentives (Pitrelli & Arabito, 2015). Resources such as funding and allocating time to practice OS are currently lacking (Gownaris et al., 2022).

OS practices: advantages and criticisms

Preregistrations and registered reports

Preregistrations are reports written prior to conducting a study, outlining hypotheses, methodology and theoretical frameworks in a detailed manner. Typically, they are time-stamped on a(n online) public registry and thus safeguard against QPRs such as hypothesizing after results are known (HARKing; Spitzer & Mueller, 2021). Similarly, registered reports involve two stages of peer review, one before and one after data collection. The major benefit of registered reports is guaranteed publication, on the condition that the study adheres to high

methodological quality standards, rather than yielding specific outcomes (Reich, 2021). Registered reports directly represent change in the current incentive structure (Nosek, B. A., & Lakens, D., 2014): such practices allow external commentators to offer feedback and strengthen theoretical frameworks.

Importantly, both preregistering and registered reports require rigorous (fore)thought about one's topic and research design. For this reason, some argue preregistration may result in increased bureaucratic burdens (Szollosi et al., 2020). Conversely, Morey et al. (2016) argue that deliberate, integrated preparations during early stages of research reduce retroactive, post-study efforts to publish openly. However, this relies on successfully educating researchers how to preregister their work efficiently.

Additionally, researcher degrees of freedom to make post-hoc changes to the preregistered plan is in question. Frankenhuis & Nettle (2018) reason that preregistration encourages exploration, granted that researchers' choices are clearly communicated and justified. Wagenmakers et al. (2012) and Nosek, B. A., & Lakens, D. (2014) highlight the preregistration's usefulness in separating hypothesis-generating and hypothesis-testing analyses. On the other hand, Pham & Oh (2021) suggest an illusion of transparency created by preregistration, since an author can preregister selectively, still choosing to omit certain hypotheses and publish them after gathering more information. Lakens (2019) enforces the view of preregistration as a tool, encouraging using it purposefully to support the goals of one's research, rather than aimlessly following a norm of preregistration. Currently, there is little agreement about which studies should be preregistered or what degree of detail preregistrations should include.

Open access, open data/code, open source

Open access (OA), open data/code and open source are related concepts, yet refer to different strategies. Firstly, OA is a free-to-read publication made available to everyone, with no copyright or licensing restrictions (Pontika et al., 2015). Secondly, open data/code refer to research data and codebooks created during the research process, made openly available. Finally, open source is freely available software (e.g., JASP, Rstudio, GitHub).

Among OS practices, OA (including open data/code and open source) is arguably most readily relatable to classical standards of science; the desired shared body of knowledge can only be achieved through open communication and shared resources among scientists (Nosek et al., 2012). Moreover, citizen science literacy may increase and empower making informed choices as a result of readily accessible scientific literature (Field et al., 2021, preprint). Arguably, publicly funded research should be made available to the public (Pownalll et al., 2021). Therefore, OA may be a step toward dismantling the ivory tower (Beals, 2013). Yet, publishing OA is currently typically funded by the authors, posing a barrier to its advance (Tenopir et al., 2011). The lack of structure surrounding available platforms and varying types of OA (gold, green or black, among others) increase the effort an author must dedicate to publishing openly. Additionally, concerns about OA resulting in an overwhelming and unnavigable mass of literature prevail in discussions.

Furthermore, open data and open material can help reduce the time and financial cost of generating new data. However, not all data can be shared: certain researchers claim being unable to share their data due to privacy concerns, especially in (but not limited to) fields such as clinical psychology (Martone et al., 2018). Moreover, some authors may acknowledge the usefulness of OA, but still choose to retain exclusive rights to data they worked intensely to collect (Savage & Vickers, 2009).

Open Peer Review

Finally, open peer review (OPR) is an old yet controversial practice. Fear of criticism or unwanted attention from others may influence both peer reviewers and authors to not engage in OPR (Teixeira da Silva, 2019). Tension between what belongs to the public and scientists' need for privacy prevails in discussions about OPR (Al-Khatib &Teixeira da Silva, 2017). Currently, the practice has neither a commonly shared definition, nor standardised protocols (Ross-Hellauer, 2017). Several practices are associated with OPR - open identity (both the reviewer's and the author's identity are disclosed), collaborative peer review (reviewers work together or with the authors), transparent peer review (the review report is published openly with the publication), among others. Furthermore, authors can choose to publish in journals dedicated to OPR, platforms dedicated to OPR or journals which allow OPR.

Inherently, OPR is argued to increase reviewer accountability, reduce bias and inconsistency of feedback and save resources such as time and effort (Ross-Hellauer & Görögh, 2019). However, many journals do not have policies to support OPR (Morey et al., 2016). Reviewing high-status authors with notable power and reputation unanimously may discourage OPR. Conversely, reviews made by early-career researchers (ECRs) who do not have an established reputation may be less trusted when their names are accessible ("Pros and Cons of Open Peer Review," 1999). Additionally, researchers across different disciplines vary considerably in their satisfaction with OPR practices (Ross-Hellerauer, Deppe & Schmidt, 2017). As such, the disciplinary context must be taken into account before imposing OPR as standard practice. The lack of standardisation and high variety between disciplines may make it difficult to adopt OPR on a large scale.

The aim of the paper

As such, the current study aims to investigate 3 aspects of status quo OS practice: a) how familiar social psychologists (SP) currently are with OS, b) to what degree OS is practiced and finally, c) what do SP deem important to facilitate practicing OS. In order to promote OS efficiently, a researcher's needs and interests must first be recorded and understood. Thus, the participants are first surveyed on how important transparency and openness are perceived to be in relation to research quality. Subsequently, the extent of (informal) training and environmental support are assessed and later correlated with the number of OS practices participants currently use. Finally, current OS practices and future interests in practicing OS are investigated. Using these early observations, this pilot study serves as a foundation for future understanding of what influences practicing OS.

Researcher Description

My academic self developed in an environment endorsing OS and encouraging partaking in the reform movement. As such, I am currently in favor of OS and intend to implement its practices during my academic career. Through engaging with literature and discussion forums, I became aware of limitations in the reformers' proposed changes. I now hold the opinion that nuance rather than extreme advocacy of any system is the key to progress and achieving a fruitful resolve to the replication crisis. As such, I hope to find nuanced answers in our participants' responses.

Methods

Ethical Considerations

Prior to sample collection, the project was approved by the BSS-Psychology Ethics Committee at the University of Groningen. The code for approval is PSY-2122-S-0016. Participation was voluntary and could be terminated at any time during the survey. Participants were required to provide informed consent prior to participating in the study. Email addresses required for survey dissemination were available publicly. Personal data such as names or email addresses, nor metadata such as IP addresses were collected.

Procedure

The participants received an email which included the link to our Qualtrics survey, as well as the informed consent and study information sheets. Additionally, information on why the participants were being contacted was provided. Furthermore, respondents were informed that the resulting data set would be used for several bachelor theses, and that data analysis may eventually result in publication in a scientific journal. The invitation email, informed consent form, and survey can be found in Appendix A. The duration of the study was three weeks, and two participation reminder emails were sent one and two weeks after our initial invitation, respectively.

Limitations of the sampling procedure

As we worked with a convenience sample, certain types of responses may be under- or overrepresented. Perhaps researchers who participated in our study are different from those who chose not to fill out the survey – participants with stronger opinions on the reform movement and its practices were more likely to answer. In addition, a participant's opinion is potentially polarized as result of a public Twitter debate (Brown, 2021). The "#bropenscience" discussion surrounding a senior academic's commentary on an early career researcher's work emerged days

prior to survey distribution. Due to the tone of the discussion, negative connotations to the reform movement may be reinforced.

Moreover, it is unknown how actively participants publish in SP over the last years. University web pages may be outdated and not account for individuals who pursued other fields of interest. However, these limitations are accounted for by asking for the participants' broad field of expertise and checking their familiarity with the replication crisis and reform movement.

Participants

Our target population consisted of social psychologists, with a desired minimum response rate of 20 participants and 10% response rate. Due to the pilot nature of the study, this threshold is rather small and arbitrary, yet deemed sufficient to test the questionnaire on its comprehensibility and internal validity. Two hundred and fourty-six psychologists were conveniently sampled from 5 Dutch universities. Researchers from University of Groningen (UG) (102), VU Amsterdam (27), University of Amsterdam (47), Tilburg University (34), Radboud University (RU) (36) were approached by extracting email addresses from their department websites. The selection sequence began with the present researchers' own university (UG) since it was expected to yield the highest response rate, followed by universities from decreasing city population size within the Netherlands. All members from the departments were included (i.e., researchers, PhD candidates, full professors and lecturers), with exception of secretaries and external affiliates. The sampling procedure ended after extracting all email addresses from the 5th university (RU).

Participant exclusion, partial responses and missing data

The total sample size (n = 94) included 2 spam/invalid responses, leaving 92 true responses. From these, 21 participants did not indicate they were social psychologists in item Q2

and 1 participant indicated not answering the survey honestly. These participants were removed from the data set, leaving the total sample size at 70 participants (incl. 11 partial responses). Out of 11 partial responses, 3 were removed from the data set due to too little information provided to be worthwhile keeping (<17% of the questionnaire was completed). The descriptive and thematic analyses (TA) included the partial responses, whereas the correlation analyses did not (n = 59).

Survey Design

The survey consisted of 12 different sections and was anticipated to take participants 15 minutes to complete. Previous unpublished qualitative work produced in former bachelor and master theses (Futjes, 2021; Hershler, 2021; Nicolai, 2021; Pool, 2021; Sales, 2021; Schmidt, 2021; Schwarzbach, 2021) were used as inspiration to assist item development. Additionally, survey designs used in studies assessing the role of replication in ecology (Fraser et al., 2020) and social psychology (Agnoli et al., 2021) were consulted. Nevertheless, the items in the survey were novel and self-generated for the purposes of this study, and cannot be found in existing validated surveys or established inventories.

Particularly relevant for this thesis were block 1, 3, 7 and 8 (see Appendix B for an overview of the survey). Block 1 offered a general demographic overview through items Q1 (country), Q2 (participants' field of expertise), Q3 (current job position) and Q4 (years worked in academia). Block 3 included items Q7 (degree of identification with the reform movement) and Q6 (participation in the reform movement), describing the participants' relationship to the reform movement. Block 7 inquired about familiarity with OS practices through items Q37 (increased transparency and openness improves quality of research), Q40 (hours spent receiving training in

OS), Q41 (perceived sufficiency of training to practice OS) and Q42 (perceived support to practice OS). Finally, block 8 evaluated the degree of OS practice usage through items Q43/Q44 (which OS practices were used and how often), as well as intentions of future usage (item Q45). All blocks were investigated during the TA to assess criticisms and praise of OS, as well as reasons for practice (dis)use.

Data Analysis

Descriptive Statistics

The open-source statistical software JASP was used to compute the descriptive and correlational analyses. Forced-choice items were analysed using descriptive methods, such as frequency tables, box plots and clustered bar graphs. All visual analogue scale questions (items Q4, Q6, Q37, Q40, Q41, Q42) were represented through box plots, showing the median and data points, including outliers. The *n*, *Mdn*, *SD* and *IQR* of each analysis was reported in-text. Due to outliers and clustered data, the median rather than the mean was chosen to represent the data, given its resistance to such occurrences.

Items Q6 (degree of identification with the reform movement) and Q7 (participation in the reform movement) explored the participants' relationship to the reform movement. A frequency table showing responses to Q6 compared the frequencies of data including and excluding partial data. The data of item Q7 was presented through three box plots, corresponding to the answers of Q7 ("Yes", "No", "Don't Know"). This distinction illustrates the degree to which participants with different participation levels (Q6) identified with the reform movement (Q7).

The frequency distributions of the responses to Q43 (which OS practices were used and how often) was illustrated in a clustered bar graph. The answer format for this item was a Likert scale with 7 possible answers: “Never”, “Rarely”, “Sometimes”, “Mostly”, “Always”, “I don’t know what this means” and “Not applicable”. The first five were operationalised by the numbers 1-5 respectively, and the last two possible answers were removed from the analysis, because they complicate the interpretation. As such, 13 “I don’t know what this means” responses were excluded, as well as 42 “Not applicable” responses.

Correlations

Three exploratory correlations were computed: Firstly, the relationship between item Q40 (number of hours spent learning about OS) and Q43 (which OS practices participants use) was explored. Secondly, the relationship between item Q41 (perceived sufficiency of training to practice OS) and item Q43 was explored. Finally, the relationship between item Q42 (perceived support to practice OS) and item Q43 was explored. All three analyses were conducted using Spearman’s rank correlation coefficient (rho). Each analysis was summarised in a table, reporting n, M, SD and ρ.

Thematic Analysis

To complement the descriptive and correlational data, a TA was conducted in partial collaboration with other students. The analysis was conducted inductively, similarly to Braun & Clarke’s (2006) guidelines. Three main questions guided the analysis: why do participants use OS, why do they not use OS, and what would they need to practice OS more frequently/easily? During the first stage, I read all open-ended answers from all blocks and extracted potentially relevant ones using the guiding questions. After reviewing exclusively the relevant answers, I created a primitive codebook, encompassing preliminary, exploratory (sub)themes that recurred

or answered (one of) the questions directly. During the second stage, I reviewed the initial codes and (sub)themes, checking for overly broad or narrow labels and adjusting them. Finally, I refined the codebook by comparing the codes between themselves, ensuring that a) the codes and themes are relevant to the question(s), b) they are not too repetitive and c) they truly reflect the answers, rather than personal interpretations.

Results

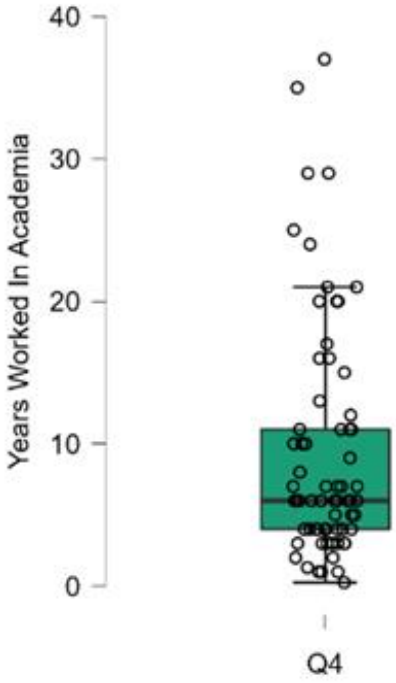
Demographics

All 70 participants are self-identified social psychologists (item Q2), although some additionally identified with other related fields: environmental psych. (*n* = 9, ~13%), I/O psych. (*n* = 5, 7%), experimental psych. (*n* = 7, 10%), quantitative psych. (*n* = 6, ~9%), political psych. (*n* = 7, 10%), developmental psych. (*n* = 2, ~3%), personality psych. (*n* = 4, ~6%) and cognitive psych. (*n* = 2, ~3%). The participants' current job position (item Q3) reveals that half the sample consists of PhD students (*n* = 35, 50%), ~23% assistant professors/UDs (*n* = 16), ~9% associate professors/UHDs (*n* = 6), ~9% full professors (*n* = 6), ~3% postdocs (*n* = 2) and 7% "other" positions (*n* = 5). Finally, 94% (*n* = 66) participants currently work in the Netherlands (item Q1), the rest working in China (*n* = 1), Indonesia (*n* = 1), Israel (*n* = 1) and Poland (*n* = 1).

Figure 1 graphically displays the self-reported years worked in academia (item Q4). Most participants cluster around six years of work and there is relatively low fluctuation between participants (*n* = 70, Mdn = 6, SD = 8.31, IQR = 7), though some outliers on the upper range indicate the inclusion of some senior researchers.

Figure 1

The Number of Years Participants Worked In Academia



Note: n = 70, *Mdn* = 6, *SD* = 8.31, *IQR* = 7

Identification With the Reform Movement

Table 1 displays the frequencies of participation in the reform movement (Item Q7), comparing the data including and excluding partial responses. The partial data includes 6 participants who identify as part of the reform movement, 4 people who were not part of the reform movement, and 1 person who reported they do not know their participation status. Thus, including or excluding partial data affects analyses including Item Q7.

In tandem, Figure 2 graphically displays the extent to which participants identify with the reform movement (Item Q6), based on their participation in the movement (Item Q7). Participants who are part of the reform movement consistently reported high degrees of identification (n =26, *Mdn* = 80, *SD* = 12.64 and *IQR* = 18.75). However, participants who are

not part of the movement show widely spread and highly varied levels of identification (n = 30, Mdn= 57, SD = 24.71 and IQR = 33.5). Finally, participants who are unsure of their membership were similarly spread and varied to the participants who were not part of the movement, though their median is higher (n = 14, Mdn = 74, SD = 25.34 and IQR = 31.25).

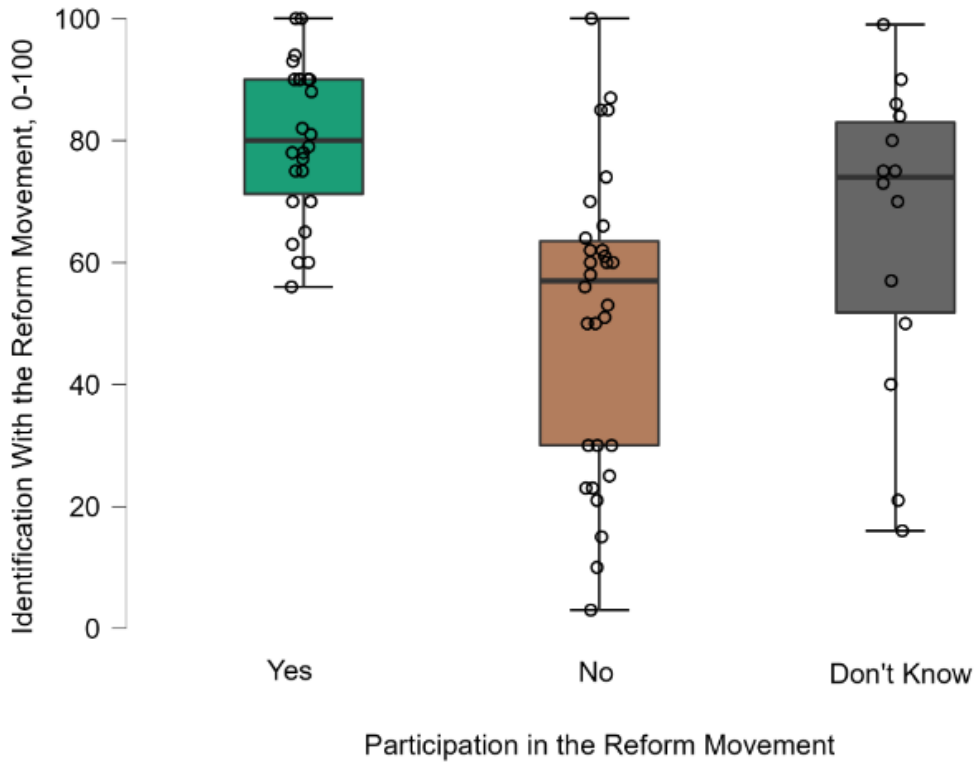
Table 1

Overview of the Frequencies of Participants Indicating Whether They Participate in the Reform Movement (Item Q7), Before and After Removing Partial Responses

Identification With the Reform Movement	Partial Responses			
	Included (n = 70)	%	Excluded (n = 59)	%
Yes	26	37.1%	20	33.8%
No	30	42.8%	26	44%
Don't Know	14	20%	13	22%

Figure 2

The Extent of Identification With the Reform Movement (Item Q6), Rated on a Scale of 0-100, Categorised by Participation in the Reform Movement (Item Q7).



Note: From left to right, the first boxplot shows *n* =26, *Mdn* = 80, *SD* = 12.64 and *IQR* = 18.75. The second boxplot shows *n* = 30, *Mdn* = 57, *SD* = 24.71 and *IQR* = 33.5. The third boxplot shows *n* = 14, *Mdn* = 74, *SD* = 25.34 and *IQR* = 31.25.

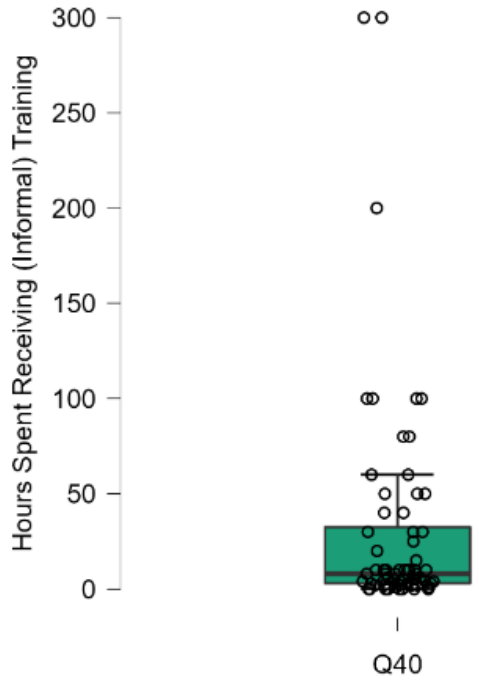
Familiarity With Open Science Practices

Figure 3 shows that a majority of participants reported receiving much less than 40 hours of training in OS practices (*Mdn* = 8, *SD* = 60.4 and *IQR* = 29.5). Indeed, though the answers cluster around the same range, participants reported struggling to estimate this number. This is reflected in the 9 outliers which skew the figure severely. A participant who reported 999 hours of training was removed from this particular analysis, because it was suspected their input was unrealistic but allowed them to continue answering the survey.

Similarly, the middle boxplot of Figure 4 shows participants reporting a widely spread perception of confidence in their OS training *(n* = 63, *Mdn* = 41, *SD* = 33.6 and *IQR* = 66). Seven participants indicated this question is “Not Applicable” to their work. They also reported highly varied and spread degrees of support from their environment to practice OS, though slightly more participants reported they completely agree they feel supported (right boxplot of Figure 4, *n* = 64, *Mdn* = 71.5, *SD* = 27.5 and *IQR* = 40). Six participants indicated this question is “Not Applicable” to their work. Finally, a majority of participants indicated they highly agree that higher transparency and openness in the research process increases research quality (left boxplot of Figure 4, *n* = 65, *Mdn* = 85, *SD* = 22.7 and *IQR* = 28).

Figure 3

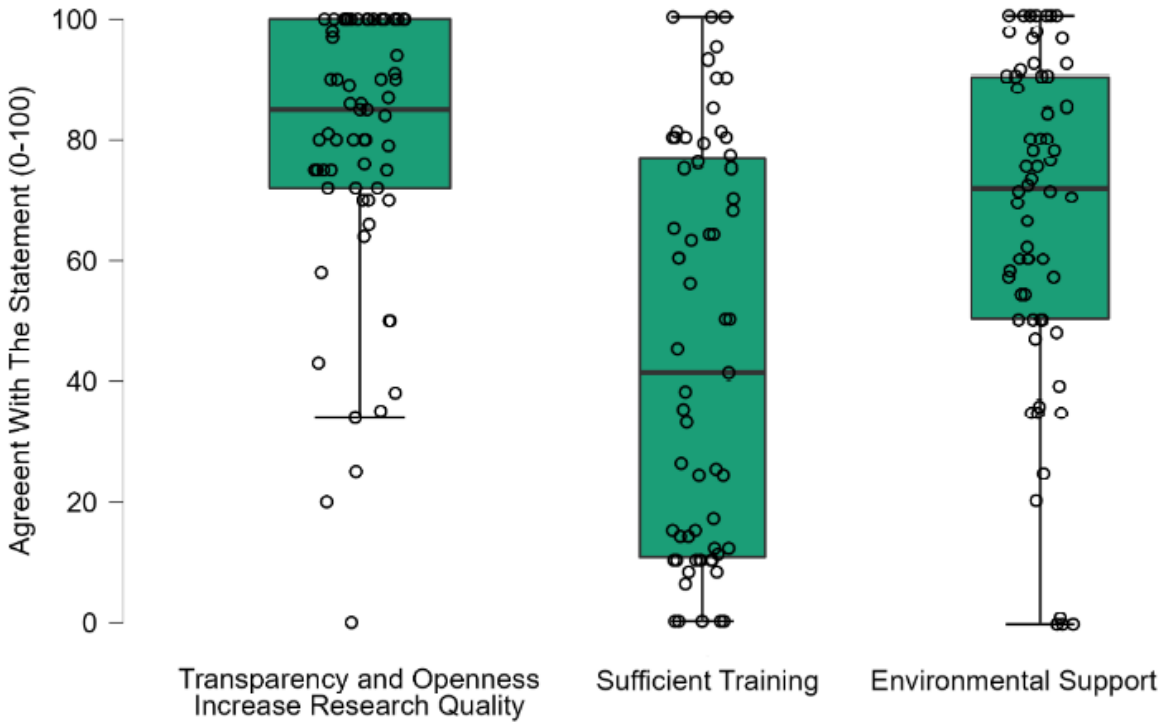
The Participants’ Estimation of The Number of Hours Spent Receiving (Informal) Training About Open Science Practices



Note: n = 64, Mdn = 8, *SD* = 60.4 and *IQR* = 29.5

Figure 4

The Participants' Assessment Whether Transparency Increases Research Quality (Q37), Whether They Received Sufficient Training in OS (Q42) and Whether They Received Sufficient Support From Their Environment to Practice OS (Q42). Rated on a Scale of 0-100.



Note: Left boxplot displays Q37: *n* = 65, *Mdn* = 85, *SD* = 22.7 and *IQR* = 28. Middle boxplot displays Q41: *n* = 63, *Mdn* = 41, *SD* = 33.6 and *IQR* = 66. Right boxplot displays Q42: *n* = 64, *Mdn* = 71.5, *SD* = 27.5 and *IQR* = 40

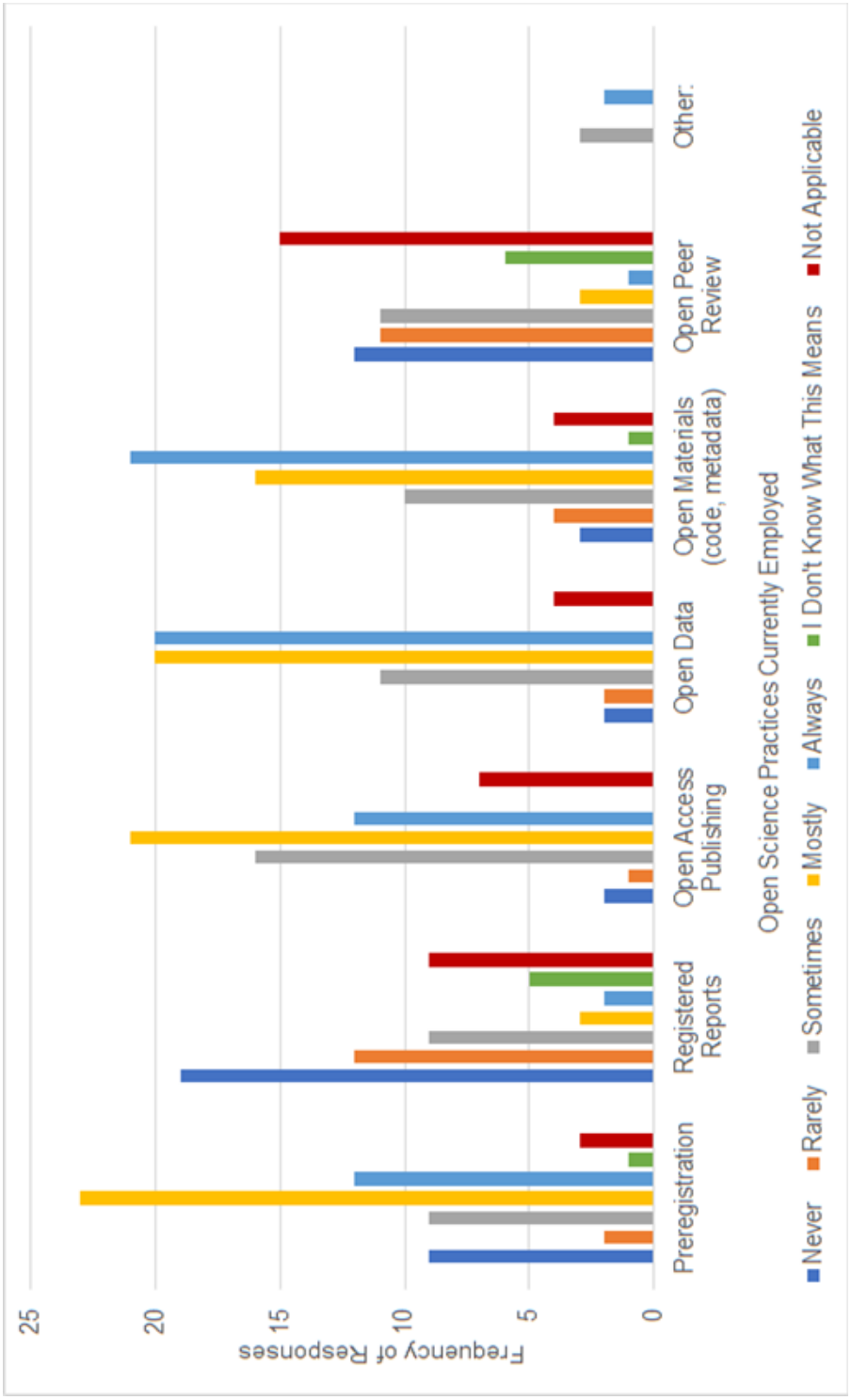
The Extent Of Open Science Practices Usage

Figure 5 shows that preregistration, OA publishing and its related practices (open data, open materials) are practices participants consistently reported employing most of the time. The

practice with least application to the participants' work is open peer review, alongside registered reports, which most participants reported practicing rarely or never. Interestingly, participants reported wishing future implementation (item Q45) of registered reports most (n = 38), followed by OA publishing (n = 33), preregistration (n = 32), open data (n = 29), open materials (code/metadata, n = 29), open peer review (n = 26). Seemingly, the practices currently implemented least are the most desired in future implementations. Two participants reported not wishing to implement any (of the mentioned) OS practices in their future work, and one participant indicated wishing to implement preprints in their future work. As such, almost all participants indicated wishing to employ at least one OS practice in the future.

Figure 5

A Clustered Bar Graph Showing the Open Science Practices Participants Currently Employ, as Well as the Frequency at Which They Report Using Them (Q43).


Frequency of Responses
25
20
15
10
5
0
Preregistration
Registered Reports
Open Access Publishing
Open Data
Open Materials (code, metadata)
Open Peer Review
Other:
Open Science Practices Currently Employed
Never
Rarely
Sometimes
Mostly
Always
I Don't Know What This Means
Not Applicable

The Exploratory Correlational Analyses

Exploratory correlations (n = 59) were computed to investigate any potential relationship between a participant's familiarity with OS practices and the extent to which they practice OS. Three variables were correlated with Item Q43 (use of OS practices), using Spearman's rank correlation coefficient (*rho*/ρ). All output tables (i.e., Table 5, Table 6 and Table 7) include the "variable" column, which represents six OS practices mentioned in the survey. Each practice was correlated with the output from Items Q40 (hours), Q41(rating scale 0-100) and Q42 (rating scale 0-100) respectively.

Firstly, the relationship between the hours spent training (Q40) and the extent to which participants reported they employ different OS practices (Q43) was explored. Table 5 shows that the preregistration variable (M = 3.49, SD = 1.33, ρ = .28), the open data variable (M = 3.98, SD = 1.03, ρ = .29) and the open materials variable (M = 3.89, SD = 1.12, ρ = .39) show weak associations to variable Q40. The other variables have very weak relationships. As such, these results are inconclusive.

Table 5

Spearman's Rank Correlation Coefficient Showing the Relationship Between Hours Spent Training (Q40) and the OS Practices Currently Used (Q43)

Variable	*n*	*M*	*SD*	Spearman's *rho*
Preregistration	55	3.49	1.33	.28

Registered Reports	45	2.04	1.15	.09

Variable	*n*	*M*	*SD*	Spearman's *rho*
Open Data	55	3.98	1.03	.29
Open Materials	54	3.89	1.12	.39
Open Peer Review	38	2.21	1.07	-.09

Secondly, the relationship between the extent to which participants felt they were adequately trained to practice OS (Item Q41) and the extent to which they use OS practices (Item Q43) is explored. Table 6 shows that the preregistration variable (M = 3.49, SD = 1.33, ρ = .27) and the open data variable (M = 3.98, SD = 1.03, ρ = .25) show weak associations. However, the open materials variable (M = 3.89, SD = 1.18, ρ = .45) shows a moderate association to variable Q41. The remaining variables have relatively similar weak associations, however there are both negative and positive relationships, rendering the overall results inconclusive.

Table 6

Spearman's Rank Correlation Coefficient Showing the Relationship Between Participants Feeling They Have Received Enough Training (Q41) and the OS Practices Currently Used (Q43)

Variable	*n*	*M*	*SD*	Spearman's *rho*
Preregistration	55	3.49	1.33	.27
Registered Reports	45	2.04	1.15	.21
Open Access Publishing	52	3.77	0.96	-.10
Open Data	55	3.98	1.03	.25
Open Materials	54	3.89	1.18	.45
Open Peer Review	38	2.21	1.07	-.13

Lastly, the relationship between the extent to which participants felt supported by their environment to practice OS (Item Q42) and the extent to which they use OS practices (Item Q43) is explored. Table 7 shows that the open materials variable (M = 3.89, SD = 1.18, ρ = .30) shows a positive weak association. Moreover, the preregistration variable (M = 3.49, SD = 1.33, ρ = .48) shows a positive moderate relationship to variable Q42. The remaining variables have very weak associations in both directions, leaving the overall results ambiguous to interpret.

Table 7

Spearman's Rank Correlation Coefficient Showing the Relationship Between Participants Feeling Supported to use OS (Q42) and the OS Practices Currently Used (Q43)

Variable	*n*	*M*	*SD*	Spearman's *rho*
Preregistration	55	3.49	1.33	.48
Registered Reports	45	2.04	1.15	.15
Open Access Publishing	52	3.77	0.96	-.08
Open Data	55	3.98	1.03	.15
Open Materials	54	3.89	1.18	.30
Open Peer Review	38	2.21	1.07	.09

Thematic Analysis

Appendix C offers an overview of the 5 themes and 10 subthemes identified, as well as the frequency at which these themes were mentioned in the answers.

Reasons for not practicing OS

Firstly, some responses (*n* = 19) deliberately distinguished between the community surrounding the reform and OS movement and its practices ("Distinguishment" subtheme). Often, this distinction revolved around finding the label "movement" problematic - "[...] It kind of requires to become part of a group when I actually just want to adopt certain practices." Additionally, certain responses noted associating participation in a movement with activism, which was not possible or desirable for some participants. In tandem with this distinction is a negative connotation with the (active) community ("Tone Issues" subtheme) - some responses expressed acute dissociation with the discussions and correspondence on social media platforms

(especially Twitter), journals or online forums. Some participants explained that the recent "#bropenscience" debate discouraged them from associating with the movement, despite initial curiosity or willingness to engage with the practices.

Furthermore, some participants identified elements of the current system which hinder using OS ("Current System" code); firstly, current reputation-dependent incentive systems may not recognise researchers expending resources to practice OS. By receiving little to no recognition from peers and journals, practicing OS may leave researchers at a disadvantage. Conversely, some participants expressed concern about OS practices gaining prestigious reputation leading to practicing OS superficially, defeating their purpose. Furthermore, differences in standard practice and norms between specific subfields lead to inequality in reception of OS. Responses reported such differences to manifest as neglecting OA funding, publication bias or reputational differences.

Finally, some participants perceived other issues in academia as more pressing than what OS addresses (e.g., theory crisis, questionable funding). Therefore, they assessed OS as peripherally helpful and did not primarily engage with its practices. Similarly, some responses argued that increased transparency will not automatically translate to improved research quality ("Quality Not Guaranteed" subcode.

Reasons for practicing OS

Participants endorsed the accessibility resulting from practicing OS (n = 14); they associated transparency and openness with increased research quality and accessibility. Moreover, participants who are no longer in academia or do not directly conduct research themselves offered peripheral support by educating their peers as a method to encourage practicing OS.

Participants whose epistemological beliefs corresponded with OS principles embraced practicing OS more readily (*n* = 14, “Congruent Philosophies” theme): "Transparency is not an option, it is our duty as scientists." Interestingly, participants who received OS-centered education early in their schooling reported feeling that OS is intrinsic in their practices. Therefore, such participants endorsed OS practices and attempted to the best of their ability to practice OS despite setbacks or limitations in the current system.

Desired improvements

A majority of responses regarding improvements conveyed a lack of funding and time constraints (*n* = 18) as significantly influencing their ability (and willingness) to practice OS: "Open access costs money which the university does not provide [...]." Though these are major complaint points, they are consequently also improvement points. Additionally, respondents perceived a generational gap in education (*n* = 8), with ECRs at disadvantage. Therefore, they urged more OS-centered education, especially targeted at ECRs.

Discussion

Summary of results

This thesis sought to answer a) how acquainted SPs are with OS (practices), b) to what extent they employ these practices and finally, c) what criticisms and improvements are considered to facilitate OS. Firstly, participants distinguished between the movement around OS and its practices, and negative connotations to the movement affected the extent of their practice and relationship to OS negatively. In practice, the benefits of practicing OS may be overshadowed by researchers’ association with activism. However, participants generally agreed that transparency and openness are indicators of good research quality (Figure 4). The TA revealed that participants endorsed the accessibility resulting from OS. Yet, some participants

considered increased accessibility insufficient to improve other underlying issues in academia, such as the theory crisis or questionable funding. Similarly, reported inequalities between specific subfields of (social) psychology create differences in terms of possibilities of practicing OS. Therefore, successful future implementation relies on customising education and recommended practices. Finally, participants expressed that funding, more OS-centered education and allotting more time to practice OS were not only currently lacking, but also the key to facilitating practicing OS.

Findings

As Crüwell et. al (2019) argued, lacking training and education about OS inhibits practice. Our participants reported that more OS-centered education/training is needed, and conversely, those whose curriculum included OS education perceived OS as a natural part of conducting research. Similar to Morey et al.'s (2016) suggestion, perhaps including OS education by default in students' curriculum may later help them perceive practicing OS as less burdensome and time-consuming. However, certain caveats must be taken into account: firstly, estimating one's training in a fixed number of hours may be especially difficult, since the terms formal and informal training are undefined. Our participants indicated struggling to estimate training, which affects the participants' estimation of confidence in receiving sufficient training. Additionally, some participants reported not knowing what certain practices are, making it difficult for them to answer authentically. Subsequently, the results of the first correlation are inconsistent and the few relationships are weak - the preregistration, open data and open materials practices seemed weakly related to the number of hours spent training in OS. The aforenamed practices are also the practices participants reported employing most of the time,

though it is unknown whether the frequency of any given practice affects this relationship. It is speculatory to assume that these are the practices the participants received most training in.

Secondly, the relationship between a participant's perception of receiving sufficient training and the number of practices employed is similarly ambiguous. The lack of operationalisation of what "feeling sufficiently trained" entails limits the conclusions that can be drawn from these analyses. Potentially interfering variables such as the extent to which a participant has access to resources that facilitate practicing OS (e.g., funding, time allocated to practice OS) are unaccounted for, further complicating interpretation.

Furthermore, the participants' perception of support from their institution and colleagues to practice OS addresses the question of how the environment can influence practicing OS. Interestingly, open access publishing is negatively associated with all three correlation variables: number of hours trained, perceptions of sufficient training and support from the environment. The direction is negative in all three analyses, despite similar practices (open data, open materials) being consistently positively associated. Participants admitted differences in norms about publishing openly in the TA, and some voiced disapproval of lack of funding. This implies that factors other than being knowledgeable about this practice or being supported by the environment affects the extent of practice, such as funding. A more thorough inspection of which factors affect which OS practices and how they are influenced is needed in future research.

Moreover, the participants reported wishing to employ the practices they currently use least in the future. For example, registered reports were rarely used currently, yet it was the practice with the highest future desirability. Similarly, our participants generally reported never or rarely practicing OPR, though the majority also reported the practice is not applicable to their work. It is plausible that different subgenres of OPR have various degrees of desirability, as

Ross-Hellerauer, Deppe & Schmidt (2017) proposed. Given that our participants signaled differences between fields in resources and norms, disciplinary context must be taken into account before imposing any OS practice as a standard. Still, 26 participants reported wishing to implement OPR in the future. Given the variety of options and lack of specific definitions, it is difficult to ascertain what type of OPR participants favour and why. Gaining an insight into such motivations in future research will contribute to facilitating OS.

General limitations

Firstly, the survey items relied on the participants' personal understanding of the OS practices - no definitions were provided by the research team. As such, it is unsurprising that some participants reported not being familiar with some practices listed, despite being generally well-establised.

Secondly, the questions about identification with and participation in the reform movement (items Q6 and Q7) did not concretely inquire about OS; therefore, it is questionable how many participants referred to OS specifically in the current study. It was assumed that because OS is a part of the reform movement, identification with the movement is synonymous with identification with OS. This is problematic, given the participants' general aversion to labelling themselves as part of a movement. This aversion may have been amplified by the "#bropenscience" debate on Twitter that occurred around the time of the study. Certain participants remarked on being negatively affected by the debate because it reminded them of the toxic discussions about gatekeeping and sexism in academia. Because contributors to discussions about the reform movement often have a poor tone, it is suspected the OS movement was freshly framed in a disadvantageous light, biasing the participants' answers. In order to collect more precise and authentic information, future research should be cognizant of the participants'

distinction between the OS movement and practicing OS and address OS separately from the reform movement.

Furthermore, our initial study duration estimation was modest compared to the participants' perception. Unfortunately, some participants reported not completing the questionnaire due to its length. Though partial responses were included in the descriptive analyses and TA, the participants' potentially valuable contributions and nuanced elaborations are disadvantaged by incompletion. Overall, the survey was comprehensive and rather versatile. However, comprehensiveness risks receiving superficial answers. As such, future developments of the study should adjust the study length expectations to avoid respondent fatigue. A balance between comprehensiveness and quality responses may be achieved by creating a thorough investigation of fewer topics. Alternatively, researchers can segment encompassing topics in a series of smaller, focused studies which summate in a larger investigation. Tangentially, the sample consisted of convenient and primarily Dutch (94%) participants. Although deemed sufficient for a pilot study, $n = 70$ is rather trivial relative to the ambitions of the survey range and potential TA nuance. Sampling a larger, diverse participant pool should help increase data quality.

Conclusion

In conclusion, the current study shows that OS is generally becoming more popular, though resources and systemic incentives are lacking to encourage practice. It is unknown what specific factors other than education and funding influence researchers, and under which conditions. Finally, advocating OS does not benefit from standardization - custom approaches and advice must be tailored to different disciplines. Future studies can further investigate how to teach OS in an efficient manner and how to create a common understanding of the OS practices.

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Appendix A

Invitation E-mail and the Informed Consent Form

Dear [title+ name],

We are contacting you, because we are doing a pilot study for a large-scale study about perceptions of the replication/credibility crisis and the 'reform movement'. In this context, social psychology is a field that is often *talked about*, but in our opinion, not *talked to* enough. We are curious how you, as a social psychologist, have experienced the crisis debate, the reform movement and the proposed changes. The results of this survey will facilitate a critical evaluation of the aims and accomplishments of the reform movement. Because this is a pilot survey, we are especially interested in your feedback about our questions (content, wording, etc.).

We kindly invite you to take part in the survey via this link:

https://rug.eu.qualtrics.com/jfe/form/SV_8quywigev6mhQa2

Participation will take approximately 15 minutes. Your contribution would be greatly appreciated!

In the attachment of this email, you can find more information about the study. Feel free to reply to this email if you have questions or concerns. If you would like to be kept up to date about this research and its results, please send us an e-mail at perceptions.of.reform@rug.nl .

Kind regards,

Robert van Ark, Maria Bompa, Kaiti Evgeniou, Colm Ó Fuartháin, Rafael Funke and Larissa Hoß

Research team:
Joyce Hoek, MSc; Nina Schwarzbach, MSc; Sarahanne Field, MSc; Merle Pittelkow, MSc; Dr. Rink Hoekstra; Prof. dr. Don van Ravenzwaaij

Faculty of Behavioural and Social Sciences, Rijksuniversiteit Groningen, the Netherlands

First Reminder Email

Dear [title+ name],

A week ago we contacted you because of our survey about “perceptions of the reform movement”, and we highly appreciate your participation. In case you did already fill out the survey: thank you very much! Please disregard this email. Unfortunately, we cannot remove you from our mailing list, since participation is anonymous.

In case you have not filled out the survey, we would kindly like to remind you that participation in our survey is still possible.

You can participate in the survey using the following link:

https://rug.eu.qualtrics.com/jfe/form/SV_8quywigev6mhQa2

In response to previously raised concerns:

- We invited 250 people to this pilot survey. Therefore, it would be difficult to trace back your identity on the basis of demographic data we ask for.
- If you’d like to give more detailed feedback verbally or via email, please do not hesitate to contact us.
- Some said that the survey takes longer than 15 minutes. Please take into consideration that it might take up to 30 minutes depending on how detailed your answers are.

Thank you in advance,

Robert van Ark, Maria Bompa, Kaiti Evgeniou, Colm Ó Fuartháin, Rafael Funke and Larissa Hoß

Research team:
Joyce Hoek, MSc; Nina Schwarzbach, MSc; Sarahanne Field, MSc; Merle Pittelkow, MSc; Dr. Rink Hoekstra; Prof. dr. Don van Ravenzwaaij

Faculty of Behavioural and Social Sciences, Rijksuniversiteit Groningen, the Netherlands

Second Reminder Email

Dear [title+ name],

We would like to remind you one last time about our survey about “perceptions of the reform movement”. You still have time to fill it out until December 8th, after which the survey will close. Your participation is still highly appreciated!

In case you did already fill out the survey: thank you very much! Please disregard this email. Unfortunately, we cannot remove you from our mailing list, since participation is anonymous.

You can participate in the survey using the following link:

https://rug.eu.qualtrics.com/jfe/form/SV_8quywigev6mhQa2

In response to previously raised concerns:

- We invited 250 people to this pilot survey. Therefore, it would be difficult to trace back your identity on the basis of demographic data we ask for. In addition, we’ve decided not to publish the data of this pilot survey on OSF or any other open data platform.
- If you’d like to give more detailed feedback verbally or via email, please do not hesitate to contact us.
- Some said that the survey takes longer than 15 minutes. Please take into consideration that it might take up to 30 minutes depending on how detailed your answers are.

Thank you in advance,

Robert van Ark, Maria Bompa, Kaiti Evgeniou, Colm Ó Fuartháin, Rafael Funke and Larissa Hoß

Research team:
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Faculty of Behavioural and Social Sciences, Rijksuniversiteit Groningen, the Netherlands

INFORMED CONSENT

"PERSPECTIVES OF THE REPLICATION CRISIS, SCIENCE AND THE REFORM MOVEMENT"

Welcome and thank you very much for participating in our survey. For more information about this pilot study, please refer to the study information form in the email or contact us at: perceptions.of.reform@rug.nl

Please read the information below and indicate whether you agree with it before continuing with this survey. You have the right to take a screenshot of this information.

- I have read the information about the research. I have had the opportunity to ask questions about it.

- I understand what the research is about, what is being asked of me, which consequences participation can have, how my data will be handled, and what my rights as a participant are.

- I understand that participation in the research is voluntary. I myself choose to participate. I can stop participating at any moment. If I stop, I do not need to explain why. Stopping will have no negative consequences for me.

I consent to participating in this study

Appendix B

The Full Survey, Containing All Questions

Start of Block 0: Informed Consent

Welcome and thank you very much for participating in our survey. For more information about this pilot study, please refer to the Study information form or contact us at: perceptions.of.reform@rug.nl. The study will take approximately 15 minutes, contains 11 sections and is best completed on a computer. Please read the information below and indicate whether you agree with it before continuing with this survey. You have the right to take a screenshot of this information. I have read the information about the research. I have had the opportunity to ask questions about it. I understand what the research is about, what is being asked of me, which consequences participation can have, how my data will be handled, and what my rights as a participant are. I understand that participation in the research is voluntary. I myself choose to participate. I can stop participating at any moment. If I stop, I do not need to explain why. Stopping will have no negative consequences for me.

I consent to participating in this study:

- Yes, I consent to participation.
- No, I do not consent to participation.

End of Block 0: Informed Consent

Start of Block 1: Demographics

First, we'd like to ask you for some demographic data.

Q1. In what country are you currently working?

▼ Afghanistan ... Zimbabwe

Q2. What is your broad field of expertise?

- Social psychology
- Developmental psychology
- Industrial and organizational psychology/ work psychology
- Environmental psychology
- Experimental psychology
- Personality psychology
- Clinical (neuro) psychology
- Cognitive psychology
- Quantitative psychology
- Biological psychology
- Political psychology
- Other, namely: _____

Q3. What is your current job position?

- (Undergrad) student
- Research Assistant
- Junior researcher
- PhD student
- Postdoc
- Assistant professor/UD
- Associate Professor/UHD
- Full professor
- Other, namely: _____

Q4. How long have you been working in academia? (years)

_____

End of Block 1: Demographics

Start of Block 2: Terms

To have a consistent and shared understanding throughout the survey, we would like to clarify what the terms mean to us. Throughout the survey, you can always go back to these definitions using a pop-up button found at the bottom.

Direct replication: The attempt to conduct a study in a manner as close to the original as possible (the same population, methodology, and statistical analyses).

Conceptual replication: The attempt to test the same theoretical process or effect as an existing study, or understand boundary conditions of given phenomena, but that uses methods that vary in some way from the previous study.

Successful replication: When the replication study yields results which are sufficiently similar to the original study in terms of the strength of the effect and whether the effect goes in the same direction as the original. 'Sufficiently similar' varies, and is usually defined by the replicating author.

Open science: Open science aims to make science more transparent. Open science practices include among others: preregistration, registered reports, open data, open peer review, and open access publishing.

Metascience: The study of research itself, often with the aim of improving its practice. Meta-researchers study the scientific community and its actors, their methods and reporting, reproducibility, evaluation, behavior, and incentives.

Reform movement: There are many different words describing groups of people that are promoting change in science, including 'meta-science movement', 'open science movement' or 'reformer movement'. In the following we summarize people sharing concern with regards to improving science through either meta-scientific or transparent/open science practices as the 'reform movement'.

Q5. Optional: Do you have feedback on these definitions?

_____

_____

From now onwards, we will refer mostly to the reform movement. You can always go back to the definitions if you are unsure about the terms used in the survey.

End of Block 2: Terms

Start of Block 3: Reform movement

The next questions will be about how the aims of the reform movement resonate with you and your research practices.

Q6. Please indicate the extent to which you...

	Not at all	Completely
...identify with the reform movement		

Q7.

Do you agree with this statement: "I am part of the reform movement."?

- Yes
- No
- Don't know

Q8. Optional: Do you have any thoughts with regard to your identification with the reform movement you'd like to add here?

_____

_____

_____

_____

Q9. Optional: Do you have feedback on the questions about identification with the reform movement?

_____

_____

_____

_____

_____

End of Block 3: Reform movement

Start of Block 4: Epistemology/Ontology

We would like to know more about how you think about science and knowledge in general. Please indicate how the following statements relate to your research.

Please indicate how the following statements relate to your research:

Not at all Completely

Q10. "For every phenomenon that I study, there are multiple valuable truths."	
Q11. "In my field of research, scientists can ultimately get to/reach the truth."	
Q12. "In my field of research, results depend on the perception of the researcher."	
Q13. "Science should be organized in such a way as to reduce scientists' biases."	
Q14. “In my field of research, the effects are dependent on the **time period** in which these studies took place rather than universal."	
Q15. “In my field of research, the effects are dependent on the **culture** where the study took place rather than universal."	
Q16. “In my field of research, the effects are dependent on the **experimental setup** rather than universal."	
Q17. "It is possible to specify all the boundary conditions that enable a theory to hold true."	

Q18. "Conducting a scientific study requires constant adaptation of the methods used."	
Q19. "The expertise of an individual scientist is important to study a phenomenon."	

Q20. Optional: Do you have any thoughts you'd like to add here?

_____

_____

_____

_____

_____

Q21. Optional: Do you have feedback on the questions about science and knowledge in general?

_____

_____

_____

_____

_____

End of Block 4: Epistemology/Ontology

Start of Block 5: Research Quality

The current survey includes some questions about the quality of research. First, we would like to know what you think of the current state of research quality in your field.

Please indicate the extent to which you agree with the following statement:

Not at all Completely

Q22. "I think that research quality in my field is something that needs to be improved."	

Q23. Optional: Can you elaborate?

_____

_____

_____

_____

End of Block 5: Research Quality

Start of Block 6: Replication

The next couple of questions will be about replication.

Please indicate the extent to which you agree with the following statement:

Not at all Completely Not applicable

Q24. "New replication studies should attempt to **generalise** established effects."	
Q25. "New replication studies should attempt to **falsify** established effects."	
Q26. “New replication studies should attempt to **confirm** established effects."	
Q27. "Original researchers of a study should participate in the process of replication."	
Q28. "I believe it is important that **direct replications** are conducted in my field."	
Q29. "I believe it is important that **conceptual replications** are conducted in my field."	

We would now like to ask some questions about replication and research quality.

Please indicate the extent to which you agree with the following statement:

Not at all Completely Not applicable

Q30. "I believe that successful **direct replications** are indicative of research quality in my field."	
Q31. "I believe that successful **conceptual replications** are indicative of research quality in my field."	

Can you elaborate on your previous two answers?

Q32. Why do you think that successful replication is, or is not, indicative of research quality in your field of research? Please indicate what type of replication you are talking about (i.e., direct, conceptual or any other form)?

_____

_____

Q33. Optional: Which quality indicators other than replication do you think are important in your field of research?

Q34. Optional: Do you have any thoughts you'd like to add here?

Q35. Optional: Do you have feedback on the questions about replication?

_____

_____

_____

_____

_____

End of Block 6: Replication

Start of Block 7: Open Science Ideas

The next couple of questions are about your ideas of open science in general.

Please indicate the extent to which you agree to the following statements:

Not at all Completely

Q36. I think that science in general should be transparent and open if possible.	
Q37. Generally, I think that the more transparent and open the research process is, the higher its quality and reliability.	

Q38. Optional: Do you have any thoughts you'd like to add here?

_____

_____

_____

_____

_____

Q39. Optional: Do you have feedback on the questions about open science ideas?

_____

_____

_____

_____

_____

End of Block 7: Open Science Ideas

Start of Block 8: Open Science Practices

The next couple of questions are about your thoughts on the practical application of open science.

Q40. Please give an estimate on how many hours of (informal) training on open science practices you have received.

_____

Please indicate the extent to which you agree with the following statements:

	Very Little	Very Much	Not applicable
Q41. "I feel like I have received sufficient (informal) training on how to practice open science."			
Q42. "My working environment/colleagues encourage me to use open science methods to conduct my research."			

Q43. Which of the following practices are you currently using in your research?

	Never	Rarely	Sometimes	Mostly	Always	I don't know what this means	Not applicable
Preregistration	•	•	•	•	•	•	•
Registered reports	•	•	•	•	•	•	•
Open access publishing	•	•	•	•	•	•	•
Open data	•	•	•	•	•	•	•
Open materials (code, metadata)	•	•	•	•	•	•	•
Open peer review	•	•	•	•	•	•	•

Q44. Optional: Alternatively, which other open science practice are you currently using in your research?

	Never	Rarely	Sometimes	Mostly	Always
Other practice:	•	•	•	•	•

Q45. Which of the following practices would you like to use (more) in your future research?

- Preregistration
- Registered reports
- Open access publishing
- Open data
- Open materials (code, metadata)
- Open peer review
- Other, namely: _____
- None

Q46. Optional: What would you need to practice (open) science the way you'd like to?

_____

_____

_____

_____

_____

End of Block 8: Open Science Practices

Start of Block 9: Critique

From interviews, we gathered some information about how the reform movement is perceived. We will now like to know how much you agree with the next statements.

Q47. Please indicate the extent to which you agree with the following statement:

	Not at all	Completely	Not applicable
"I have the feeling that people in the reform movement understand the practices of my field."			

Q48. Optional: Please explain why (not)?

_____

_____

_____

_____

_____

Please indicate the extent to which you agree with the following statement:

Not at all Completely Not applicable

Q49. "I feel like the reform movement addresses the most pressing issues regarding scientific quality in my field."	

Q50. Optional: Please explain why (not)?

_____

_____

_____

_____

Please indicate the extent to which you agree with the following statement:

Not at all Completely Not applicable

Q51. “The proposed solutions solve the problems in my field sufficiently.”	

Q52. Optional: Please motivate your answer.

_____

_____

_____

_____

Q53. The reform movement prioritizes some solutions over others. Please rank how **you think** the reform movement prioritizes the following issues (1=most priority, 16=least priority):

_____ Preregistration/registered reports

_____ Data/code sharing

_____ Research methods other than inferential (qualitative, descriptive, exploratory)

_____ Improving statistics (bayesian statistics vs NHST etc)

_____ Theory or construct development

_____ Bigger sample sizes

_____ Slow science

_____ Managing competitive culture in academia

_____ More collaboration

_____ More direct replication

_____ More conceptual replication

_____ Increasing diversity within universities

_____ Increasing the importance of societal impact

_____ More freedom to pursue your scientific interests

_____ More job security

_____ Nuanced reporting of results

Q54. Are you sure you finalised the ranking?

- Yes, I am
- No, I am not

Q55. Optional: What problems with regard to the quality of research in your field is the movement missing?

_____

_____

_____

_____

_____

Q56. Optional: Do you have feedback on the questions about the priorities of the reform movement?

_____

_____

_____

_____

_____

End of Block 9: Critique

Start of Block 10: Important Issues To Be Addressed

Q57. In order to improve **research quality** in your field, multiple solutions are suggested. Please rank how important **you think** they are to improve research quality in your field (1=most important, 16=least important).

_____ More focus on preregistration/registered reports
_____ More focus on data/code sharing
_____ More focus on research methods other than inferential (qualitative, descriptive, exploratory)
_____ More focus on improving statistics (Bayesian statistics and/or NHST etc.)
_____ More focus on theory or construct development
_____ More focus on bigger sample sizes
_____ More focus on slow science
_____ More focus on managing competitive culture in academia
_____ More focus more collaboration
_____ More focus on direct replication
_____ More focus on conceptual replication
_____ Increasing diversity within universities
_____ Increasing the importance of societal impact
_____ More freedom to pursue your scientific interests
_____ More job security
_____ More focus on nuanced reporting of results

Q58. Are you sure you finalised the ranking?

- Yes, I am
- No, I am not

Q59. Optional: Did we forget something?

_____

_____

_____

_____

_____

Q60. Optional: Do you have feedback on the questions about the important issues to be addressed?

_____

_____

_____

_____

_____

End of Block 10: Important Issues To Be Addressed

Start of Block 11: Obstacles to Implementation

Researchers also report various obstacles to reforming science. How much do you agree with the following statements?

Not at all Completely Not applicable

Q61. “Open science does not sufficiently take into account privacy issues for studies with sensitive data.”	
Q62. “Open sciences practices are too time-consuming.”	
Q63. “At this moment, open science practices are not rewarded or incentivised enough.”	
Q64. “Practicing open science gives me a competitive **advantage** over other scientists.”	
Q65. “Practicing open science gives me a competitive **disadvantage** over other scientists.”	
Q66. "The critique about my field of research from the reform movement makes me feel like I have to prove my innocence."	
Q67. "The tone of the members of the reform movement should be more nuanced."	

Q68. "I am less likely to engage with the propsed reform practices because I feel the reform movement is prejudiced toward my field of research."	

Q69. Optional: Do you want to elaborate on any of your answers with regard to obstacles for reform?

_____

_____

_____

_____

Q70. Optional: What other obstacles for changing the practices of your field do you see?

_____

_____

_____

_____

_____

End of Block 11: Obstacles to Implementation

Start of Block 12: Feedback

You've now reached the end of the survey.

Q71. Would you like to give more specific feedback on the survey?

_____

_____

_____

_____

_____

Q72. I have honestly answered the questions above.

- Yes
- No

Q73. I paid attention filling in this survey.

- Yes
- No

Please press → to submit your answers. You cannot change your answers anymore after submitting.

End of Block 12: Feedback

Appendix C: The final codebook of the thematic analysis					
Question Answered	Code	Subcode	Explanation	Example quote(s)	Tally
Disuse	Community	Tone issues	Negative connotations of the OS community from toxic discussions and correspondence on social media and journals (e.g., #bropenscience). Expressions of hesitation to identify with OS and the movement around it because of the	"The recent debates on sexism and and the bro culture within the open science community, have not helped my identification	8
		Distinguishment	A desire to separate practicing OS from participating in the OS movement or generally in the reform movement. The term movement is the problematic factor.	"I find the term movement problematic. It kind of requires to become part of a group when I actually just want to adopt certain practices."	19
	Current System	Reputation and Incentives	Concerns about not getting recognition or status from publishing open access in the current system and therefore being at a disadvantage. Voicing concerns about the current system undermining the surfacing of OS through not recognising OS as a reputable (publication) practice.	"Without making major changes to the publication process, I don't think any solution we have now will be quite "sufficient". See e. g. open access journals	16

Appendix C: The final codebook of the thematic analysis					
Question Answered	Code	Subcode	Explanation	Example quote(s)	Tally
				being considered "less prestigious".	
		Quality Not Guaranteed	Argumentation pointing out that simply increasing transparency or openness will not automatically improve research quality.	"[...] There will always be people who find ways to conduct bad science even if they present their research within a transparent/open system."	9
		Underlying Issues	Some participants perceive other issues in psychological research to be more pressing than the replication crisis (e.g., the theory crisis, questionable funding). Otherwise, participants consider practicing OS insufficient or a distraction from solving issues.	"The open science movement thinks that pre-reg, open materials, and better stats will cure the problems. But the underlying problem is a lack of good theory. None of these things really helps with that."	12

Appendix C: The final codebook of the thematic analysis					
Question Answered	Code	Subcode	Explanation	Example quote(s)	Tally
Use	Accessibility	Transparency and openness	Endorsement and appreciation of the accessibility of research (incl. materials, data, code etc.) which comes as a result of the increased transparency and openness that OS advocates.	"Researchers should be transparent about their choices, however. And the more reflexive and transparent a research is the higher the quality."	14
		Peripheral support	Not participating in the OS movement or not conducting (OS) research, but educating others about OS.	I don't feel that I know enough to contribute directly to the core 'movement' (e.g., contributing to conferences or Reproducibilitea meetings), but I am still part of the periphery of the movement because I am trying to adopt OS practices and also teach these to my students.	2

Appendix C: The final codebook of the thematic analysis					
Question Answered	Code	Subcode	Explanation	Example quote(s)	Tally
	Epistemological Beliefs	Congruent Philosophies	A participant's epistemological beliefs align with the goals and practices of OS. Therefore, a participant considers that OS practices (such as publishing openly) should already be standard practice. Participants whose education included OS practices and consequently their current regular practices include OS are also included in this category.	"Transparency is not an option, it is our duty as scientists."	14